

A NEW GENUS, *PRISCABDELLA*, FOR AQUATIC JAWED  
SANGUIVOROUS LEECHES FROM FLINDERS ISLAND,  
NORTH-EAST TASMANIA, AND SOUTHERN SOUTH  
AUSTRALIA (HIRUDINOIDEA : RICHARDSONIANIDAE).

by

LAURENCE R. RICHARDSON  
4 Bacon Street, Grafton, N.S.W.

*Manuscript received 21/3/1973*

*Published 18/5/1973*

---

ABSTRACT

*Priscabdella* resembles *Richardsonianus* and *Habeobdella* in the general morphology of the reproductive systems, differs from these in having salivary gland papillae, and from all other Richardsonianidae in having a variable pattern limited to incomplete narrow contrast stripes along the paramedian lines and lateral in the paramedian fields. A detailed topographic analysis leads to the conclusion that *Priscabdella* conforms to a 7-banded pattern. A tropical-subtropical origin is proposed on the presence of salivary gland papillae.

On the nature of the pharynx and associated structures, the morphology of the reproductive systems, and the general somital annulation, the leeches detailed here belong in the Richardsonianidae, and would be associated with the g. *Richardsonianus*.

They differ in having salivary gland papillae on the jaws, a feature recorded previously (v. Sóos, 1969) only in some of the genera of the tropical-subtropical belt. The presence of these structures in the leeches described here, is a departure from a broadly-based zoogeographic 'rule'.

They differ also in pattern. In these leeches this consists of an inner and an outer pair of colour stripes, the outer pair or both pairs more or less interrupted anteriorly, and showing much individual variation. The appearance is monotone decorated by spaced thin narrow colour contrast stripes.

The pattern otherwise in the Richardsonianidae is boldly banded longitudinally with colour contrast stripes and dark bands continuous from in and near the ocular arch to the terminal somites of the body, with significant interruptions only in the median band, and rarely minor interruptions in other bands in some few individuals.

The nature of the variation in pattern in the few specimens of the new genus is paralleled among Australian terrestrial auriculate jawed sanguivorous leeches in which the pattern consists of longitudinal dark bands with contrast stripes and/or elongate contrast maculae. In some species, not yet described, the stripes and bands are complete in some specimens; the stripes broken anteriorly in others; and the stripes suppressed anteriorly in others; all from the one location. In the new genus, as in the terrestrial leeches, the tendency is for the pattern to persist on the posterior portion of the body and to exhibit suppression on the anterior portion of the body.

The nature of the topographically defined pattern in the Richardsonianidae is reviewed later in this paper. This shows that there is a basic element of pattern common to all genera, including the new genus, and two primary forms of pattern.

I also review the basis for the zoogeographic 'rule' concerning genera having salivary gland papillae on the jaws.

In preparing the review of pattern, I was led to examine again Benham's accounts (1904, 1907) of *Hirudobdella antipodum*, the only 'jawed sanguivore' in this Region which cannot be admitted to either the Richardsonianidae or the Ornithobdellidae; nor is there any other established family suitable for it. The pharynx terminates in xii, and accordingly the caecate crop is unusually short. In the two established families in this Region, the pharynx terminates at viii/ix, or in ix; etc.

Additional to the above and other differences (Richardson, 1969), I now find that Benham (1904, pl. viii, fig.2) clearly shows that the dorsal median field in *antipodum* is much wider than the paramedian fields, being almost twice the width of a paramedian field in somite iii back into somite ix.

As shown here (Fig. 1, a, b.), as in all other Australian aquatic jawed sanguivores, the median field from in v and posteriorly along the body, is always much narrower than the paramedian field, the median about half of the width of the paramedian field along the greater length of the body.



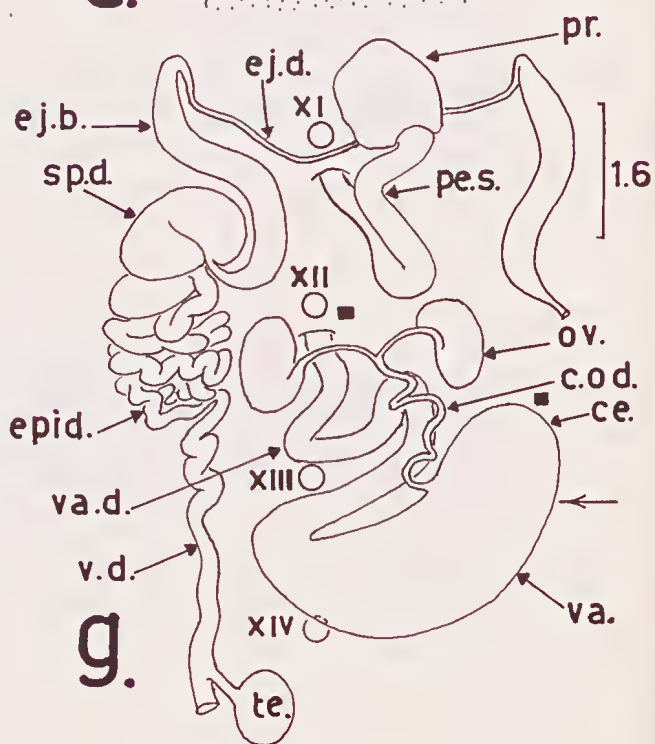
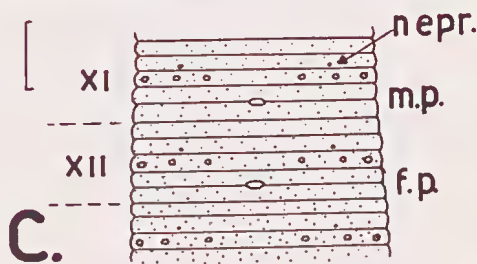
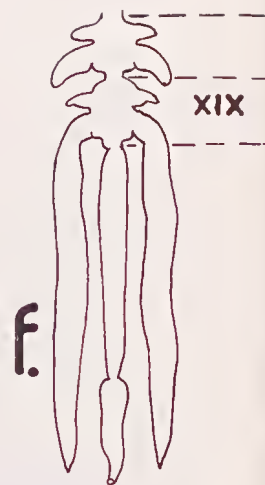
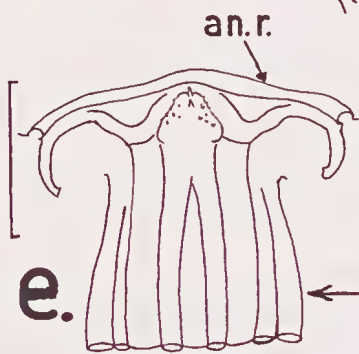
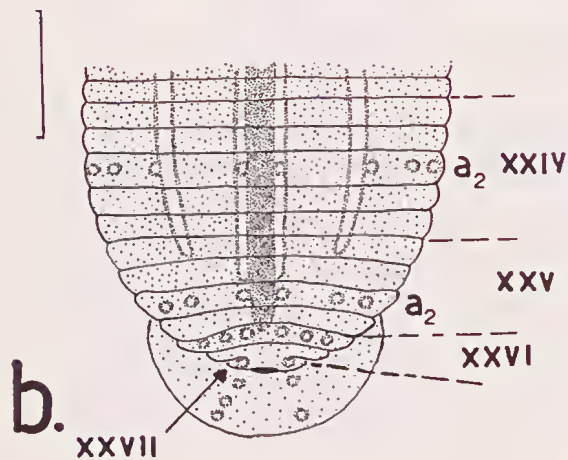
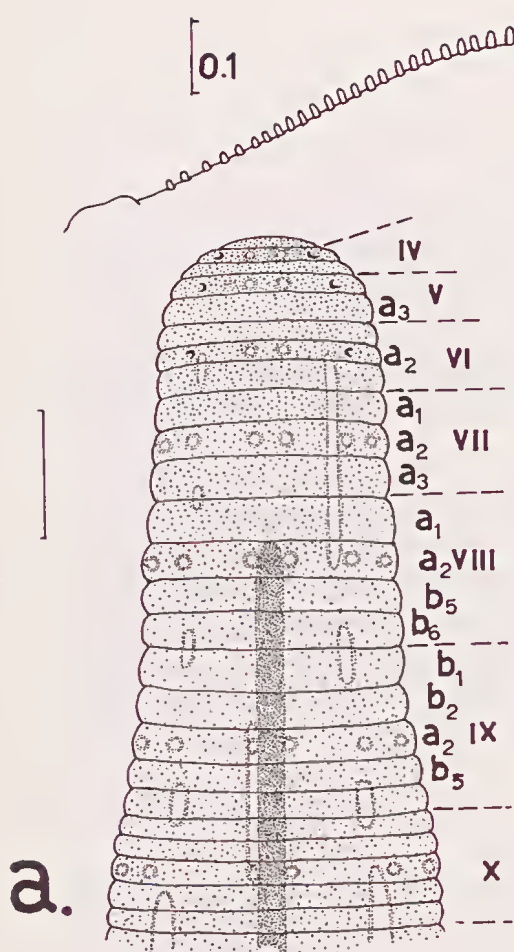


Fig. 1. *Priscabdella hickmani* g. et sp. nov. All illustrations taken from the type. a. Dorsal aspect, somites iv to x, and b. somites xxiv to xxvii, showing somital annulation and topography of pattern. c. Ventral aspect, somites xi and xii, showing nephropores, genital pores etc. d. Dental margin of right ventrolateral jaw, arrow indicates medial end. e. Jaws and internal muscular ridges of pharynx exposed by a median ventral longitudinal incision, arrow marks midpoint in length of pharynx. f. Crop compartments, somites xviii and xix, caeca, postcaeca, intestine and rectum. g. Anterior region of male paired ducts, medial aspect with dorsal aspect to left; male median region; female reproductive system, vagina displaced to show left medial aspect, arrow indicates dorsal aspect, black square the original location of end of caecum.

Somites and somital ganglia indicated by Roman figures; annuli, 'a<sub>2</sub>' etc.; somital ganglia shown at relative size; scales in millimeters, 2.0 mm, or as indicated.

Abbreviations: an.r., annular ridge; ce., caecum; c.od., common oviduct; ej.b., ejaculatory bulb; ej.d., ejaculatory duct; epid., epididymis; f.p., female pore; m.p., male pore; nepr., nephropore; ov., ovary; pe.s., penis sheath; pr., prostate; sp.d., sperm duct; te., testis; v.d., vas deferens; va., vagina; va.d., vaginal duct.

spaced longitudinal yellow stripes on the dorsum. Under the lens, uniformly dark slate grey, plumbeous, on all aspects. A pair of very faintly yellow narrow stripes along each side of the dorsal midline, and an outer pair of wider distinctly yellow stripes about half way between the inner pair and the margins. A dorsal median longitudinal band is black, darker than the general background colour, and occupies the full width of the median field.

Pattern. Fig. 1, a, b, c.

Preserved. On the dorsum, a dark band along the median field; an inner pair of narrow, weak pale contrast stripes along the lines of the paramedian sense organs; an outer pair of wider, stronger light contrast stripes are lateral in the paramedian fields.

The dorsal median band completely fills the median field and is detectable from in ix to xxvii. Anterior to ix, the field is of the background colour.

The inner pair of contrast stripes are very narrow, uniform in width, each no more than 1/5th of the width of the median band, occupy the line of the paramedian sense organs, and extend from in ix to xxvi/xxvii. There are vague indications that these stripes extend anterior to ix, and might be broken.

The paired stripes lateral in the paramedian fields are narrow anteriorly, wider posteriorly as the body width increases, to be not more than the width of the median band. They extend from in vi a<sub>2</sub>, just medial to the 5th eyes, as separated patches mostly on b<sub>6</sub> and b<sub>1</sub> back into x and then continuous from the middle of x to xxiv/xxv or to just enter xxv.

There are no marginal stripes excepting anteriorly where the margin is slightly paler than the general background colour, which is continuous across the intermediate and marginal fields onto and across the venter along the greater length of the body.

Annulation. Fig. 1, a, b, c.

Preserved, contracted so that the annuli are longitudinally high convex. Interannular and intersomital furrows, strong, equivalent; somital limits not generally recognizable as such; no obvious areolation; somital sense organs obvious everywhere on the dorsum in white circles, detectable on the venter; sensillae, obvious as wide-spaced white points; nephropores, obvious as small pits close to the posterior border of a<sub>1</sub> or b<sub>2</sub>, just medial to the ventral intermediate line in viii to xxiv.

Annulation of i, ii, and iii, indefinite; the 1st two pairs of eyes, minute, obscure; iv, 2-annulate, a<sub>1</sub>a<sub>2</sub> with the 3rd pair of eyes and 1st obvious paramedian and supramarginal sense organs <a<sub>3</sub>, and iv forming distinct dorsolateral lobes on the margin of the sucker; v, 2-annulate above, a<sub>1</sub>a<sub>2</sub> with the 4th pair of eyes = a<sub>3</sub>, a<sub>1</sub>a<sub>2</sub>/a<sub>3</sub> terminates in the ventral intermediate fields so that uniannulate v forms only the ventral margin of the sucker; v has the first complete set of somital sense organs; vi, 3-annulate above, a<sub>1</sub><a<sub>2</sub> with the 5th pair of eyes <a<sub>3</sub>, a<sub>1</sub>/a<sub>2</sub> terminates in the marginal fields, and vi 2-annulate below with a<sub>1</sub>a<sub>2</sub> = a<sub>3</sub>; vii, 3-annulate, a<sub>1</sub> = a<sub>2</sub><a<sub>3</sub> (= viii a<sub>1</sub>); viii, 4-annulate, a<sub>1</sub> with the 1st pair of nephropores slightly >a<sub>2</sub> = b<sub>5</sub>>b<sub>6</sub>; ix to xxiv, complete 5-annulate (total 16); ix, b<sub>1</sub> = b<sub>2</sub><a<sub>2</sub>>b<sub>5</sub>>b<sub>6</sub>; x, b<sub>1</sub> = b<sub>2</sub> = a<sub>2</sub>>b<sub>5</sub><b<sub>6</sub>, as also xi but with b<sub>5</sub>>b<sub>6</sub>; somites xiii to xx, irregularly contracted so that the somital annulation is not fully assessable

with confidence, but the general annulation of the midnephric series appears to be,  $b_1 = b_2 = a_2$  (? slightly > or =)  $b_5 > b_6$ ; xxi,  $b_1 = b_2 < a_2 > b_5 = b_6$ ; xxii, distinctly  $b_1 < b_2 < a_2 > b_5 = b_6$ , as also xxiii; xxiv,  $b_1 < b_2$  with the last nephropores =  $a_2 > b_5 = b_6$ ; xxv, 4-annulate  $b_1 = b_2 = a_2 < a_3$ , and  $a_2$  the last annulus complete across the venter; xxvi, 2-annulate  $a_1 a_2 > a_3$ ; xxvi/xxvii, incomplete across the median field; xxvii, uniannulate, much reduced; anus at the posterior border of xxvii.

Posterior sucker with 5 or 6 concentric rings of areolae on the dorsal surface, and about 48 muscular rays near the margin on the ventral surface.

Genital pores, xi and xii  $b_5/b_6$ .

Body wall and muscular system

Body wall, moderately heavy; the two layers of oblique muscles, equivalent and relatively thin; longitudinal layer, thicker, more strongly developed with heavy, close, wide muscle strands.

Dorsoventral muscles, sparse; paramedian palisades present as spaced bundles of fine strands in the contiguous portions of adjacent somites; intermediate palisades, almost a uniform row of individual strands.

Alimentary tract. Fig. 1, d, e, f.

The lower surface of the margin of the velum is almost smooth, divided into flat areolae some having a central sensilla-like structure. This surface terminates with a low, rounded soft transverse fold which continues ventrally onto the inner surface of the lateral portion of the wall of the sucker at v/vi and has the nature of an annular ridge. Behind this there is a deep poorly formed annular groove in vi and the anterior part of vii. The surface of the groove is smooth, and the groove houses the jaws, the soft wall of the groove folding into temporary longitudinal ridges between the jaws, each then being housed in a deep pocket which is not a permanent structure.

In end view, the jaws are about as tall as wide at the base; the sides, concave; the dental margin obtusely rounded and in side view, initially straight, then progressively convex.

Salivary gland papillae are distinct on the sides of the jaws. The papillae are large, coarse, well-spaced, and typical in form.

The dental margin of the right ventrolateral jaw has 48 narrow tall teeth, the tallest (0.045 mm) at the medial end; the height of the row reducing more abruptly in the medial third than in the remainder of the row so that teeth in the middle of the row are 0.022 mm high, and the last ten or twelve teeth are low, almost granular.

The entrance to the pharynx is posterior in vii, restricted by the bases of the jaws, and no more than the width of the base of the dorsomedian jaw.

The wall of the pharynx is thin, with six thin internal muscular ridges arranged as a pair on each of the dorsomedian and ventrolateral aspects; the ridges of each pair fusing into a single ridge which enters the base of the corresponding jaw. No ridges end independently on the margin of the entrance to the pharynx.

The pharynx terminates with a sphincter in the middle of ix. The extrinsic radial muscles are an obvious system in vii back into x.

Spaced individual salivary gland cells are present in vii to x. These are sparse. There is no obvious aggregation of the ducts into columns.

The crop is thin-walled, lined with a longitudinally rugose epithelium, and divided into somital compartments; the 1st, a short narrow, acaecate compartment in the posterior half of ix. In x to xviii, each compartment carries a pair of simple caeca anterior on the compartment, and a second pair along the median region of the compartment; both about equal in size in x, then progressively the posterior the larger and longer, extending into the paramedian chambers from xiii to xviii; the compartment in xix carries a pair of small anterior caeca, and the postcaeca which originate from the lateral aspects of the median portion of the compartment, extend into the paramedian chambers, and terminate in xxvi.

The intestine is tubular, lined with a transversely rugose epithelium, connects terminally to the crop, is acaecate, and ends with a sphincter at xxiii/xxiv, where it connects terminally to the acaecate tapering tubular rectum.

Reproductive systems. Fig. 1, g.

Male gravid; female, mature. Median regions, bimyomeric, mesomorphic. Genital pores, xi and xii b<sub>5</sub>/b<sub>6</sub>.

Testes, simple saccular; the posterior on the left at xxi/xxii, the vas deferens extending to xxii/xxiii commencing with an undeveloped testis in the paramedian chamber, and the most anterior testis at xiii/xiv, i.e. 9 testes on the left, those in xxi/xxii to xiii/xiv all in the median chamber, connecting each by a short vas efferens to the convoluted vas deferens in the paramedian chamber which becomes thin-walled in xiii, extends to xii/xiii and expands into a convoluted much folded epididymis in the posterior half of xii; male duct continued as a much wider coiling sperm duct in the contiguous halves of xi and xii; sperm duct narrowing abruptly to connect terminally to the ventral end of the elongate fusiform muscular ejaculatory bulb which is ventral for the first third, ascendent, and dorsal for the terminal third, terminating by narrowing and turning ventrally as a narrow muscular ejaculatory duct which enters the median chamber and passes into the ventral face of the prostate covering the atrium.

The male median region extends as a penis sheath along the recurrent and procurrent limbs of a posteriorly directed loop reflected in the middle of xii, the whole in the median chamber.

The female reproductive system is entirely in the median chamber. The single pair of simple saccular ovaries is situated in the posterior half of xii at the level of the epididymis; oviducts, thin-walled, delicate, long, joining to form a common oviduct which commences without a distinct atrium.

The median region is formed on a posteriorly directed loop in the vertical plane, reflecting at xiii/xiv. The thin-walled common oviduct is little wider than an oviduct, short, occupying no more than the 1st half of the recurrent limb, much folded on itself, partially associated with the vaginal duct which is about twice the length of the common oviduct.

The vagina completes the recurrent limb and extends briefly onto the procurrent limb. It consists of a very large caecum extending to ganglion xii



the length and width of the caecum both equal to the width of the vagina. The caecum and body of the vagina are dorsal to and conceal the oviducts, common oviduct, and vaginal duct.

The vagina reduces gradually around the elbow of the loop, the median region continuing as a long wide strongly muscular vaginal duct which occupies the length of the procurvent limb and is thrown into wide compact loops before terminating at the female pore.

The prostate glands form a cap totally covering the male atrium and extending briefly along the penis sheath. The albumin glands are a thick ensheathment of the anterior 1/3rd of the common oviduct.

#### Paratype

General form and colour, as type.

Pattern much less complete than in the type. The median band is not black, only very slightly darker than the general background colour of the dorsum, and recognizable from in v to xxv a<sub>2</sub>.

The inner paired contrast stripes along the lines of the paramedian sense organs are generally vague, not detectable anterior to xiii, both indicated faintly from in xiv posteriorly into xxiv, nowhere showing as obvious continuous stripes but as an interrupted series of spaced faint very narrow elongate patches each extending over only a few annuli.

The outer paired contrast stripes lateral in the paramedian fields are of the width in the type, both much more reduced, more broken and shorter than in the type, and asymmetrical, the left shorter than the right.

Both are represented by a patch on v a<sub>3</sub> into vi a<sub>1</sub>; the left with a small patch anterior and another posterior on vi a<sub>3</sub> and a minute patch on viii b<sub>5</sub> and on ix b<sub>6</sub>; the right with patches on ix b<sub>5</sub> and b<sub>6</sub>, and x a<sub>1</sub>; both stripes then vaguely indicated on the contiguous annuli of x and xi, more strongly in xi a<sub>2</sub> to xi b<sub>6</sub> and in xii a<sub>2</sub> to xiii b<sub>1</sub>; then the left continuous from in xiii b<sub>6</sub> to xv b<sub>2</sub>, and the right more weakly indicated from in xvi a<sub>2</sub> to xvii a<sub>2</sub>.

Otherwise, the general background monotonous above and below, excepting for obvious white circles enclosing the somital sense organs, nephropores, and genital pores.

General somital annulation as in type. The furrows i/ii and ii/iii, not detectable; ii, with the 1st pair of eyes also has distinct intermediate somital sense organs; iii, the 2nd pair of eyes, and distinct paramedian and supramarginal sense organs; iv, the 3rd pair of eyes, and distinct paramedian, supramarginal and marginal sense organs; vi, the 1st complete series of somital sense organs; relative lengths of annuli in v to viii, as in type; ix to xviii, not assessable with confidence, but xii and xiv as in type; xviii and xx, as xxi in type. In general, a<sub>2</sub> the longer annulus in the midnephric and postnephric series; xxv b<sub>2</sub>, the last complete annulus.

Alimentary tract. Lower surface of the velum, annular ridge and annular groove and the housing of the jaws, as in type. Salivary gland papillae, minute, arranged in at least three rows parallel to the dental margin on the dorsomedian jaw.

Wall of pharynx, thin; dorsomedian muscular ridge, not subdivided; ventrolateral ridges, as in type. Crop, intestine etc., as in type.

Reproductive system. Essentially as in type; epididymis, more extensively developed; ejaculatory bulbs subfusiform, almost vertical, and lateral to the prostate; penis sheath, reflected at ganglion xii; female system as in type, excepting the midregion of the vaginal duct more coiled than in type.

#### Additional material

The following have the characteristics of the q. *Priscabdella*. All differ from the type in lacking a black median band, the median field being the same as the general background colour of the dorsum. Leeches in (a) and (b) from north-eastern Tasmania have obvious contrast stripes along the paramedian lines essentially complete from within the ocular area to and into xxvii; in (c), from southern South Australia, these stripes are very vague, consistently broken on  $a_2$  from in xxvii to  $x a_2/b_5$ , and a few minute patches anterior to this. All have distinct wide pale bands in the submarginal fields, separating the dorsum from the venter along the length of the body.

The general appearance suggests two species separate from the type; but the material is limited, not uniformly preserved, and for the time being I assign them provisionally as *Priscabdella* (?) *hickmani* with the anticipation that reasonable series will enable the recognition of these as representative of other species in the genus.

- (a) Gladstone Lagoon, north-east Tasmania. Collected 2/11/72, R. Mawbey and B. Knott. Per Dr. P. S. Lake, University of Tasmania.

One specimen, 45.0 mm long; extended, strongly depressed.

Preserved. Slate grey on all aspects, the margins slightly paler; contrast stripes of the paramedian lines, pale yellow, narrow, no wider than the sense organs, present on iii to v, broken along vi, then essentially continuous to xxvi/xxvii. Contrast stripes lateral in the paramedian fields, yellow, narrow (2/3rds width of median field), present on vii  $a_2$  and  $a_3$ , faintly indicated on viii on the left, elongate patches on both on ix  $b_6$  and  $x b_1$ , and both essentially continuous from just in xi  $a_2$  to xxiv/xxv.

Dorsal median field uniform in colour along its length, very faintly darker than the general background colour of the dorsum, but nowhere an indication of a definite dark black band.

General somital annulation as in type. Somites xvi to xxii,  $b_1=b_2=a_2=b_5$  slightly  $>b_6$ ; xxv  $a_3$ , last annulus complete across venter; xxvi/xxvii, lacking in median field; genital pores, xi and xii  $b_5/b_6$ .

Pharynx and associated structures as in type; jaws with distinct salivary gland papillae.

General morphology of the reproductive systems, as in type; ejaculatory bulbs, fusiform; penis sheath folded into a short anteriorly directed secondary fold; vaginal caecum, large, of the width of the vagina, the length just shorter than the width, and the caecum just shorter than in type.

(b) Cape Portland Lagoon, north-east Tasmania. Collected 2/11/72, B. Knott and R. Mawbey. Per Dr. P. S. Lake, University of Tasmania.

Four specimens, preserved, strongly contracted: 27.0 mm, 28.0 mm, 28.0 mm, and 29.0 mm.

In the hand, almost black; under the lens, grey on the dorsum, the venter paler grey and immaculate, dorsum and venter separated by a pale band in the submarginal field, the band distinctly paler than the venter. Dorsum of the posterior sucker, grey; the venter of the colour of the submarginal band.

Dorsal median field, grey, of the general colour of the dorsum.

Inner paired contrast stripes of the paramedian lines, narrow, distinct in all, very faintly yellow; commencing in iii or iv a<sub>1</sub> and extending back into xxvii; both broken from xii a<sub>2</sub> to xiii a<sub>2</sub> in one, from xv b<sub>5</sub> to xvi a<sub>2</sub> in a second, and complete in two.

The outer paired stripes are lateral in the paramedian field; yellow; narrow (2/3rds width of median field); symmetrical in the 29.0 mm specimen with elongate patches on vii a<sub>3</sub> and viii a<sub>1</sub>, on ix b<sub>2</sub>, on x b<sub>5</sub> and b<sub>6</sub>, and then continuous from xi a<sub>2</sub> to end at xxiv/xxv. Asymmetrical in the others. The 27.0 mm specimen has patches on both sides in vii a<sub>2</sub> and a<sub>3</sub>, the left continuous from xi b<sub>6</sub> to xviii a<sub>2</sub>, broken to xix a<sub>2</sub>, continuous from in xix b<sub>5</sub> into xxiii b<sub>2</sub>, with patches on xxiii b<sub>6</sub> and xxiv b<sub>1</sub>; the right continuous from xiii b<sub>1</sub> to xxiii b<sub>2</sub>. One 28.0 mm specimen has patches on the left in xi b<sub>5</sub> and xii b<sub>2</sub>, then continues from in xii a<sub>2</sub> to xv b<sub>1</sub>, broken to xvii a<sub>2</sub>, and continues from in xvii b<sub>5</sub> to end in xxv b<sub>1</sub>; on the right, continues from in xiii b<sub>1</sub> to end in xxiv a<sub>2</sub>. The other has small patches on the left on viii b<sub>5</sub> and ix b<sub>1</sub>, then continuous from in ix b<sub>5</sub> to end in xxiv b<sub>2</sub>; on the right, an elongate patch on viii b<sub>5</sub> and b<sub>6</sub>, then continuous from in x b<sub>1</sub> to end in xxiii b<sub>2</sub>.

General somital annulations as in type, but vii a<sub>3</sub> distinctly > than viii a<sub>1</sub> in 3 specimens (27.0, 28.0, 29.0 mm); a<sub>2</sub> long and recognizable by its length in the midnephric somites of 3 specimens; xxv a<sub>3</sub>, the last complete annulus in all; xxvi/xxvii, lacking in the median field in all.

In the 27.0 mm specimen, the furrows viii b<sub>5</sub>/b<sub>6</sub> and ix b<sub>1</sub>/b<sub>2</sub> are lacking across the median field and these annuli are distinctly coupled as viii (b<sub>5</sub>=b<sub>6</sub>) and ix (b<sub>1</sub>=b<sub>2</sub>); these furrows complete in the other specimens, the annuli still coupled, but in the 29.0 mm specimen ix b<sub>1</sub> distinctly < b<sub>2</sub>.

The 27.0 and 29.0 specimens dissected. Pharynx and associated structures, as in type; salivary gland papillae, small but distinct.

Ejaculatory bulbs inflated subfusiform in the 27.0 mm specimen, fusiform in the 29.0 mm specimen; penis sheath reflecting at xii in both; vagina fully inflated in both, the vaginal caecum expanded to be shorter than wide.

(c) North Para River, Rowland's Flat; 2 miles North, 2 miles East of Lyndoch, South Australia. Collected, 10/1/71, F. Parker, (No. 923). Per Mr. M. Tyler, South Australian Museum. Deposited, South Australian Museum, Adelaide.

One specimen. Preserved, contracted, total length 73.0 mm.

General form, background colour, and pattern, as type.

There is no indication of a black median dorsal band. The inner paired contrast stripes along the lines of the paramedian sense organs, indicated very vaguely by small paler grey narrow patches, an individual patch on each 'b' category annulus from in xxvii anteriorly to x a<sub>2</sub>/b<sub>5</sub>; otherwise, only on the left, a small patch on vii a<sub>2</sub> and a<sub>3</sub>, another on vi a<sub>2</sub> and a<sub>3</sub>, and v a<sub>1</sub>a<sub>2</sub>. There is a transverse patch of yellow on ix b<sub>2</sub> which extends across the median field and just enters the paramedian fields.

The outer paired contrast stripes lateral in the paramedian fields, are narrow as in the type, brightly yellow, and fully obvious; on the left, an elongate patch on viii b<sub>5</sub> to ix b<sub>2</sub>, a minute patch on the contiguous annuli of ix and x, and then continuous from x a<sub>2</sub>/b<sub>5</sub> back into xxiv b<sub>2</sub>; on the right, an elongate patch from iv/v to vii a<sub>1</sub>, a patch on viii b<sub>5</sub> to ix b<sub>2</sub>, then essentially continuous from x a<sub>2</sub>/b<sub>5</sub> back into xxiv b<sub>2</sub>.

Supramarginal fields of the colour of the dorsum; submarginal fields distinctly pale grey, paler than the light grey of the venter.

General somital annulation as in type. Relative lengths of annuli cannot be assessed with any confidence.

Pharynx and associated structures as in type. The salivary gland papillae are very obvious on all jaws, more so than in type. The teeth are somewhat larger and more crowded than in the type, but the row has the same form: initially large, tall teeth, the row then rapidly reducing in height over the next few teeth, and reducing more gradually beyond this so that the greater length of the row appears relatively uniform in height.

General morphology of the reproductive systems, as in type; ejaculatory bulbs subvertical, elongate fusiform; the penis sheath, as in type; female median region with the common oviduct connecting closer to the end of the vagina than in type, and the vaginal caecum shorter than wide.

## DISCUSSION

Two matters relating to the new genus warrant more detailed examination. These are the evidence in the Richardsonianidae of systematic and other values in the topographic description of pattern; and the distribution of aquatic jawed sanguivores having salivary gland papillae on the jaws.

The inclusion of colour and pattern in specific descriptions of leeches continues from pre-linnean zoology as a simple generalized description which is still used by some workers (v. Sawyer, 1972); or by some few, an intimately detailed topographic description in terms of the longitudinal lines of cutaneous somital sense organs, the fields between these lines, and the somital annulation.

The value of the latter technique was shown by Whitman in 1886. It was used extensively over many years by Moore from 1901. It provides a precision in the description of pattern in leeches which is exceptional among soft-bodied invertebrates.

As shown in the present leech (Fig. 1, a, b, c.), the morphologically central (neuromeric) annulus in each somite carries six spaced dorsal and six spaced ventral somital sense organs with one other in each marginal area.

These are regularly arranged and form recognizable longitudinal lines: right and left dorsal paramedian, intermediate and supramarginal lines; right and left ventral paramedian, intermediate and submarginal lines; and a marginal line along each side (v. Fig. 1, b, xxiv).

The fields on the dorsal and ventral aspects are: the median field, between the paramedian lines; the paramedian fields, between the paramedian and intermediate lines; the intermediate fields, between the intermediate and supramarginal or submarginal lines; the marginal field, between the supramarginal and submarginal lines, or the marginal field may be recognized as divided into supramarginal and submarginal fields divided along the line of the marginal sense organs, usually midway between the supramarginal and submarginal lines.

The width of the body of the leech increases along its length. It will be seen (Fig. 1, a, b.) that this increase in width occurs with increase in width of the paramedian fields on the dorsum, the median field (Fig. 1, c.) on the venter; and that the other fields are relatively constant in width along their length. This is a simple indication of the morphological stability of the lines of the sense organs.

Not all leeches exhibit topographically definable pattern. Some are monocolourous; others, sparsely to richly maculate, the maculae not referable to lines or fields. Patterns are topographically definable where there are metameric maculae restricted to definite annuli in each somite and relatable to the topographic lines and fields; or there may be longitudinal stripes of light contrast colour and longitudinal bands, complete or interrupted, and with a precise topographic arrangement.

Genera were long defined mainly on the external meristic morphology combined with the general nature of the pharynx and the crop. Since the latter conforms to habit and, with some few exceptions external meristic morphology is monotonous in aquatic jawed sanguivorous leeches, the number of "genera" was relatively small; the content of the "genera", heterogenous; and the "species" in a "genus" were diverse in pattern. From this was established the tradition that pattern had no systematic value other than at the species level. There could be no familial value in pattern in the former cosmopolitan F. Hirudinidae which included terrestrial and aquatic jawed sanguivorous leeches; jawed and jawless macrophagous aquatic and terricolous leeches; etc.

In my studies on aquatic and terrestrial jawed sanguivores and other leeches of the Australian and other regions, I have shown that the combination of the organisation and relationship of structures on the anterior region of the male paired duct, with the detailed nature of the pharynx and associated structures, and the morphological forms of the median regions of the reproductive systems, closely defines genera and differentiates genera among leeches of common habit and similar external meristic morphology.

This led to the fragmentation of the former Hirudinidae into families of zoogeographic regional status, with two such in the Australian region.

In one, the Ornithobdellidae, pattern is not topographic in the two genera as so far known, *Ornithobdella* and *Aetheobdella*, excepting an occasional specimen of the latter has a black band along the dorsal median line.

In the other, the Richardsonianidae, the pattern as known to me until now has consisted of essentially complete, uninterrupted longitudinal dark bands and light contrast colour stripes along the dorsum in seven of the eight previously defined genera. The pattern in the eighth, the g. *Euranophila* Richardson 1969, as noted in the field by Dr. H. Cogger, includes a narrow interrupted median band between two narrow orange red stripes; otherwise, dark brown with orange red margins.

In the seven genera, and hence possibly also in *Euranophila*, the paramedian lines of sense organs are contained in light contrast colour, a very narrow stripe in those with a median band, and typically the sense organs median in the stripe; or in the absence of a median band, as in *Goddardobdella* Richardson 1969, the paramedian sense organs are lateral in the broad stripe which occupies the median field and extends into the paramedian lines.

The only appreciable variation I have seen is in *Kaiyabdella* Richardson 1972. In most specimens, the paramedian sense organs are central in a narrow paramedian stripe; in some few, the median band is wider, the sense organs nearer to the medial than to the lateral border of the stripe; in others, the band may contact, partially, or almost entirely enclose the sense organs; but in none are the stripes shifted so as to be distinctly in the paramedian fields.

It may be noteworthy that in my few good specimens of '*Hirudo*' ('*Limnobdella*') *mauiana* Benham 1907 from New Zealand, a leech having a strong resemblance to the g. *Richardsonianus* Sós 1968, the paramedian lines of somital sense organs are distinctly included within the median band and the paramedian fields contain each a narrow inner stripe separated by a wider dark band from an outer stripe of about the width of the band, and the outer stripe extends into the intermediate lines and includes these sense organs. I have not seen this combination yet in any Australian specimens of the g. *Richardsonianus* or of the other genera.

In *Quantenobdella* Richardson 1969 the paramedian fields are each completely occupied by a wide dark band with a narrow stripe along each line of intermediate sense organs. In the other genera, the paramedian fields contain each a medial inner band and a lateral outer stripe. In *Richardsonianus* the band and the stripe are much of the same width and the stripe is extended into the intermediate line to include these sense organs.

In *Goddardobdella*, *Eunomobdella* Richardson 1969, *Bassianobdella* Richardson 1970, *Kaiyabdella* Richardson 1972, and *Habeobdella* Richardson 1972, the band in the paramedian field is wider; the stripe, narrower and the stripe is restricted to the paramedian field. The stripe does not include the intermediate sense organs. The intermediate line of sense organs are included in a band which may extend briefly into the paramedian and intermediate fields, or as in *Habeobdella* occupy the greater part of the intermediate field.

In *Habeobdella*, the supramarginal lines and fields are occupied by a contrast stripe. In *Richardsonianus*, the intermediate fields are each occupied by a band which may or may not extend to include the supramarginal lines, and the supramarginal lines and fields may be included in a marginal stripe, or the stripe restricted to the supramarginal field on the dorsal aspect. This is much the same in *Quantenobdella*, excepting that the bands of the intermediate fields are short, and terminate in somite xi. In this manner, these three genera have a pattern which can be termed 5-banded: a median band; a band in each of the paramedian fields; a band in each of the intermediate fields.

In *Goddardobdella*, *Bassianobdella*, *Kaiyabdella* and *Eunomobdella*, the intermediate field is occupied by a narrow stripe; the line of supra-marginal sense organs is included in a band which extends briefly into the contiguous fields, or may continue laterally into the supra-marginal field, and the supra-marginal field may be included in a stripe or a band. Accordingly the pattern for *Goddardobdella* is 6-banded, there being no median band; and 7-banded in the others which have this band.

It can now be seen that the pattern in *Priscabdella*, although variable, the dark colour of the median band sometimes suppressed as also the contrast colour of the stripes; the median band complete or shortened; the stripes, more or less interrupted, etc., can be assessed as having: a median band; the lines of the paramedian sense organs included in contrast stripes; the paramedian field, containing a wide band in the medial portion and a contrast stripe lateral in the field and reduced to be narrow.

As such, *Priscabdella* has the basic pattern present in the 5-, 6-, and 7-banded genera with the exception of *Quantenobdella*, a genus which on morphological grounds cannot be associated with any other genus in the family.

The 7-banded *Bassianobdella* and *Kaiyabdella* can be associated also on the morphology of the median regions of the reproductive systems, general somital annulation, etc. *Eunomobdella* and *Goddardobdella* can be associated on the morphology of the median regions of the reproductive systems, differ in general somital annulation, the presence of salivary gland papillae on the jaws in *Goddardobdella*, etc., with the weak and interrupted median band in *Eunomobdella* assessable as a measure of suppression of the band which is lacking in *Goddardobdella*.

*Priscabdella*, *Richardsonianus*, and *Habeobdella*, can be associated on the morphology of the median regions of the reproductive systems. The general somital annulation of *Habeobdella* is unique in the family, setting this genus apart from the other two both with the same general somital annulation.

In line with the other examples, it would seem that this association of *Priscabdella* with two 5-banded genera would indicate that the pattern in *Priscabdella* is assessable as a reduced form of the 5-banded pattern. Accepting this, the restriction of the paramedian contrast stripe to the paramedian field and the exclusion of the intermediate line of sense organs from this stripe in both *Habeobdella* and *Priscabdella* set these two genera apart from *Richardsonianus* in which these sense organs are included in the paramedian contrast stripe.

This difference gains significance when it is appreciated that the paramedian contrast stripes are restricted to the paramedian field and the intermediate line of sense organs are excluded from this stripe in *Bassianobdella*, *Kaiyabdella*, *Eunomobdella*, and *Goddardobdella*, genera in which the intermediate field is occupied by a contrast stripe, and not a band as in both *Habeobdella* and *Richardsonianus*. All bands are of the same strength in the two latter genera; the median band darker in the 7-banded genera, as also in *Priscabdella*.

We are led then to the conclusion that the pattern in *Priscabdella* is either a reduced or not fully developed 7-banded pattern.

In the aquatic jawed sanguivores, all the ducts from the salivary glands may terminate along the base of the row of teeth, or some and possibly all may terminate in papillae on the sides of the jaw. The papillae may be uniform in size, or vary with larger papillae closer to the dental margin. It might be considered that such papillae are remnant from an earlier macrophagous condition; but there is nothing as yet to support this, nor any acceptable explanation for the presence of such papillae in some kinds, and absence from other kinds of aquatic jawed sanguivores in the same area.

The dentition of the jaws was closely examined by many earlier workers. In the literature available to me, there is no reference to papillae earlier than Whitman, who in 1886 described and figured a considerable number of "wart-like prominences" on the sides of the jaws of *Hirudinaria javanica* of Batavia. Whitman included this only as an item in description.

The presence or absence of papillae was given systematic value by Blanchard (1893:28) who considered them to be typical of the g. *Limnatis* and for this reason assessed *Poecilobdella* and later *Hirudinaria* as subgenera in *Limnatis*. I review briefly (1972) the unfortunate consequences following from Blanchard. Even now, it is possible in some areas to refer only to group-complexes when considering leeches having salivary gland papillae on the jaws.

The basis for a zoogeographic 'rule' that aquatic leeches with salivary gland papillae on the jaws are restricted to the tropical-subtropical belt, is in the distribution of: the '*Limnatis*-complex' (Mediterranean, Ethiopian, Oriental); the '*Hirudinaria*-*Poecilobdella*' complex (Oriental); *Asiaticobdella* Richardson 1969 (Oriental); *Aliolimnatis* Richardson 1972 (Ethiopian); *Limnobdella* Blanchard 1893, *Pintobdella* (Caballero 1937) Richardson 1969, (Sonoran, Neotropical); and in the Australian Region, *Goddardobdella* (north-eastern New South Wales, Queensland, Northern Territory, Papua New Guinea), and the monotypic *Quantenobdella* (Lord Howe Island).

The genera having these papillae cannot be assembled into a single systematic group, as was attempted by Blanchard. Each is a component of its own zoogeographic fauna. The zoogeographic 'rule' has a broad zoological basis. As with other such 'rules', it provides no more than an hypothesis usable in seeking understanding of data which cannot be encompassed within the systematic framework.

The broad zoological basis of the 'rule' has warranted the assumption that a leech possessing such papillae is tropical-subtropical in distribution, and that systematic relationship for the leech is to be found within this faunal component in its Region. It has also been assumed in the past that such a relationship will be found only with other genera which also possess these papillae.

This is not the case in the Australian Region. Of the nine genera here which lack papillae, four are subtropical in distribution. Of the latter, one, *Kaiyabdella*, is closely associated with the southern g. *Bassianobdella*.

The application of the 'rule' to *Quantenobdella* on the basis of its distribution and the possession of salivary gland papillae does not become unreasonable simply because no relationship has yet been found to any other genus in the Region.

The distribution of *Goddardobdella* is fully typical of the 'rule'. If



in seeking relationship for *Goddardobdella* we take guidance from former long established practise and place major value on the number of complete fully annulate somites, *Goddardobdella* with ix to xxiii complete fully annulate (total 15), stands apart from all other genera in the family, these all having ix to xxiv complete 5-annulate (total 16).

If we place primary systematic emphasis on the form of the female median region, *Goddardobdella* becomes associated with *Eunomobdella*, both subtropical in distribution, both lacking a vaginal duct which is present in all other genera in the family.

*Eunomobdella* lacks salivary gland papillae. The third assumption as set out for the 'rule' above cannot be sustained. Equally, we can no longer rely on the number of fully annulate complete somites as a primary guide to relationship among genera.

The form of the female median region associates *Priscabdella* with *Richardsonianus* and *Habeobdella*. The known distribution for all three is essentially Bassian.

The zoological basis for the 'rule' is so broad that the 'rule' cannot be abandoned in the case of a single exception.

There remains then the high probability that the 'rule' is applicable to *Priscabdella*. If so applied, *Priscabdella* is to be assessed as tropical-subtropical in origin. The relationship of *Priscabdella*, *Richardsonianus*, and *Habeobdella*, favours a similar origin for the two latter genera.

Since *Priscabdella*, *Richardsonianus* and *Habeobdella* are entirely sanguivorous, there can be no reason to consider that the unusual incompleteness and variability of pattern in *Priscabdella* has a primary nutritional basis.

Accepting a tropical-subtropical origin for *Priscabdella*, it is reasonable to assume that the variability in pattern comes from partial failures in some secondary physiological process based on an enzyme series for which temperature optima for one or more enzymes are not adequately available in the present environment. The variability in pattern is the expression of some measure of failure in physiological adaptation, an adaptation which has been accomplished by *Richardsonianus* and *Habeobdella*.

#### POSTSCRIPT

*Priscabdella* sp. ?. National Museum of Victoria, G. 827. Wilsons Promontory, Vic. Coll. J. A. Kershaw. Xmas. 1905. One specimen, 26.0 mm, strongly contracted, unsuitable for dissection. Dorsum, plumbeous; median field of the general background colour; contrast stripes, weakly yellowish, those of the paramedian lines, narrow, complete from v/vi to in xxvii, those lateral in and about  $\frac{1}{2}$  the width of the paramedian field, of the same length; dorsum divided sharply from the pale grey venter; no marginal stripe; general somital annulation, as in type; iv/v, the first furrow; a<sub>2</sub> distinctly long in the midnephric series; xxv a<sub>3</sub>, the last complete annulus; well-formed annular groove housing jaws with large obvious papillae; medial teeth stronger than in type.

## ACKNOWLEDGEMENTS

The new species is named for Professor V. V. Hickman in appreciation of his many significant and diverse contributions to Australian zoology, including leeches.

I express my thanks to the Director, the Queen Victoria Museum and Art Gallery, Launceston and to Mr. R. H. Green, Zoologist to the Museum, for the opportunity to study and report on the specimens from Flinders Island: to Mr. M. J. Tyler, the South Australian Museum, for the specimen from Lyndoch, South Australia; and to Dr. P. S. Lake, the University of Tasmania, Hobart, and Messrs. R. Mawbey and B. Knott, for the specimens from north-east Tasmania.

This study was conducted under an award from the Australian Research Grants Committee.

## REFERENCES

- BENHAM, W. B. 1904. xxi. On a new species of leech (*Hirudo antipodum*) recently discovered in New Zealand. *Trans. N.Z.Inst.* 36: 185-192.
- 1907. Two new species of leech in New Zealand. *Idem.* 39: 181-193.
- BLANCHARD, R. 1893. Révision des Hirudinées du Muséum de Turin. *Boll. Mus. Zool. Anat. Comp. Turin.* 8(145): 1-32.
- RICHARDSON, L. R. 1969. A contribution to the systematics of the hirudinid leeches, with description of new families, genera, and species. *Acta Zool. Hung.* 15 (1-2): 97-149.
- 1972. *Bassianobdella fusca* sp. nov. (Hirudinoidea: Richardsonianidae), with an initial demonstration of systematic values in the lengths of annuli in the mid-nephric somites. *Rec. Aust. Mus.* 28(8): 129-139.
- SAWYER, R. T. 1972. North American freshwater leeches, exclusive of the Piscicolidae, with a key to all species. III. *Biol. Monogr.* 46: 1-154.
- SOOS, A. 1969. Identification key to the leech (Hirudinoidea) genera of the world, with a catalogue of the species. v. Family Hirudinidae. *Acta Zool. Hung.* 15 (1-2): 151-201.